SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING OCTOBER, 1916.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Washington, D. C., Nov. 28, 1916.]

For a description of instrumental exposures, and an account of the methods of obtaining and reducing the measurements, the reader is referred to the REVIEWS for January, April, and May, 1916, 44:2, 179, 180, and 244.

The monthly means and departures from normal values of Table 1 show that direct solar radiation intensities averaged about normal at Washington, D. C., slightly above normal at Lincoln, Nebr., and decidedly above at Madison, Wis., and Santa Fe, N. Mex. Noon intensities of 1.46 calories at Madison on October 16, and 1.53 calories at Lincoln on October 25, exceed any previous intensities measured at these stations in the month of October; while noon intensities of 1.57 calories measured at Santa Fe on October 19 and 21 equal any October reading previously obtained at that station.

TABLE 1.—*Solar radiation intensities during October, 1916.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.
Oct. 1					1.15	1.10				
6		1.13								
7		1.01	0.83	0.68	0.56					
8						0.53		0.48	0.44	
9		1.23								
10		1.39	1.35	1.24						
11		1.21	1.15	1.07						
12		0.92	0.80							
14			1.27	1.18						
21		1.37	1.26	1.15						
23			1.21	1.07						
24		1.11	1.09	1.05						
25			0.93	0.91						
26		1.31	1.21	1.11						
27		1.19	1.04	0.94	0.84					
28		1.35	1.23	1.12	1.04	0.97	0.90	0.84		
Monthly means		1.20	1.11	1.05	0.90	0.87	(0.90)	(0.66)	(0.44)	
Departure from 8-year normal		−0.03	±0.00	+0.03	−0.03	−0.01	+0.03	−0.13	−0.32	
P. M.										
Oct. 6		1.12	1.07	0.98	0.86	0.77	0.70	0.65	0.60	0.56
7		1.07	1.07	0.92	0.82	0.72	0.66	0.62	0.56	
8				0.84						
10		1.39	1.30	1.22	1.13	1.07	1.02	0.96	0.90	
11		1.24	1.07	0.96	0.86	0.79	0.72	0.65	0.58	
14		1.36	1.26	1.15	1.08	1.02	0.95	0.89	0.84	0.79
17		1.21	1.11	0.99	0.87	0.77	0.71	0.67	0.61	0.54
23		1.26	1.20	1.10	1.01	0.94	0.87	0.81	0.75	0.69
24			0.88				0.64	0.60	0.57	0.53
26			1.19	1.09	1.00	0.92	0.84	0.79	0.73	0.67
27			0.99	0.90	0.80	0.70	0.64	0.59	0.56	0.52
28			1.14	1.05	0.87	0.77				
Monthly means		1.24	1.12	1.02	0.93	0.85	0.78	0.72	0.67	0.61
Departure from 8-year normal		±0.00	+0.01	±0.00	+0.02	+0.02	+0.01	+0.01	±0.00	−0.01

Madison, Wis.

A. M.										
Oct. 3		1.18	1.05	0.95	0.86	0.78				
4		1.16	1.04	0.95	0.92	0.86	0.78			
6		1.35	1.28	1.20	1.13	1.07	1.01			
10		1.47	1.37	1.29	1.22	1.15	1.10	1.06		
13		1.44	1.31		1.17	1.09				
17		1.37	1.33	1.29	1.21					
27			1.33	1.25	1.19	1.09				
Monthly means		1.33	1.24	1.16	1.10	1.01	0.96	(1.06)		
Departure from 7-year normal		+0.10	+0.10	+0.08	+0.09	+0.10	+0.12	+0.35		

TABLE 1.—*Solar radiation intensities during October, 1916*—Continued.

Madison, Wis.—Continued.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
P. M.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.
Oct. 3			1.09	1.02	0.95					
4			1.03	0.90	0.81	0.72				
6		1.23	1.19	1.01	0.96	0.91	0.87			
7		1.17	1.14							
10		1.46	1.35	1.26			1.07			
13			1.36	1.30	1.24	1.17	1.11	1.06	1.01	
17			1.35							
27					1.12	1.06				
Monthly means		1.20	1.22	1.10	1.02	0.96	1.02	(1.06)	(1.01)	
Departure from 7-year normal			+0.07	+0.01	+0.03	−0.01	+0.08	+0.30	+0.37	

Lincoln, Nebr.

A. M.										
Oct. 3		1.36	1.26	1.16	1.07	1.01	0.93	0.88	0.84	0.77
4		1.29	1.18	1.09	1.00	0.93	0.87	0.80	0.73	0.66
6		1.34								
10			1.33	1.22	0.97					
13		1.51	1.43	1.34	1.27	1.20	1.06	1.00	0.97	
17			1.37	1.29	1.16	1.08	1.02	0.95	0.91	
20			1.51	1.43	1.34	1.27	1.23	1.19	1.15	
25		1.56	1.48	1.41	1.33	1.26	1.19	1.13	1.09	
31			1.36	1.31	1.20	1.10	1.01			
Monthly means		1.41	1.36	1.28	1.17	1.12	1.04	0.99	0.95	(0.72)
Departure from 2-year normal		+0.03	+0.04	+0.03	+0.01	+0.03	+0.03	+0.05	+0.05	±0.00
P. M.										
Oct. 2		1.20	1.01	0.85	0.75	0.67	0.57	0.48	0.41	
3		1.30	1.12	1.02	0.94	0.87	0.80	0.73	0.69	0.66
4		1.24	1.06							
13			1.36	1.29	1.22	1.15	1.09	1.02	0.97	0.94
16		1.39	1.21	1.09	1.02	0.96	0.90	0.86	0.82	0.79
17		1.43	1.34	1.25	1.16	1.06	1.01	0.96	0.91	0.85
20		1.51	1.46	1.40	1.32	1.26	1.22	1.16	1.09	1.01
21		1.47	1.36	1.25	1.15	1.08	1.01	0.96	0.93	
26		1.40	1.26	1.17	1.09	1.01	0.97	0.93	0.89	
27		1.49	1.38	1.28	1.18	1.11	1.05	1.00	0.96	0.92
31			1.39	1.29	1 20	1.12	1.06	1.00	0.95	0.90
Monthly means		1.38	1.27	1.19	1.10	1.03	0.97	0.91	0.86	0.87
Departure from 2-year normal		−0.01	+0.01	+0.02	±0.00	−0.01	−0.01	−0.01	−0.01	+0.01

Santa Fe, N. M.

A. M.										
Oct. 2		1.43	1.35	1.29	1.24	1.18	1.13	1.08	1.02	0.98
3		1.53	1.46	1.38	1.31	1.25	1.20	1.14		
6			1.40							
16			1.39							
17		1.47	1.29	1.26	1.23	1.18	1.13	1.08	0.97	
18		1.44	1.35	1.21	1.13	1.11				
19		1.55	1.44	1.36	1.31	1.26	1.21	1.17	1.12	
20		1.56	1.48	1.41						
21		1.57	1.51	1.45	1.39	1.35	1.33	1.31	1.27	1.20
25		1.51	1.44	1.37		1.26				
26		1.57	1.51	1.43	1.37	1.31	1.25	1.21		
27					1.29	1.26	1.23	1.20	1.17	
28		1.53	1.47	1.42	1.36	1.31	1.27	1.23		
30		1.56	1.48	1.41	1.34	1.28	1.23	1.19	1.16	1.14
31		1.56	1.49	1.42	1.36	1.30	1.26	1.20		1.06
Monthly means		1.52	1.43	1.37	1.30	1.25	1.22	1.18	1.12	1.10
Departure from 4-year normal		+0.05	+0.07	+0.06	+0.09	+0.10	+0.09	+0.04	+0.03	
P. M.										
Oct. 2		1.51	1.37	1.30	1.24	1.19	1.13	1.08		
17		1.47	1.38	1.32	1.25	1.18	1.13	1.09		
19		1.57	1.48	1.40	1.31					
20		1.54	1.43	1.36	1.29	1.23	1.17	1.12		
25		1.51	1.44	1.36	1.28	1.20	1.16			
26		1.52	1.44	1.37	1.31	1.25	1.20	1.15		
28			1.43	1.34	1.25	1.18	1.15			
30			1.44	1.37	1.31	1.24	1.20	1.16		
Monthly means		1.52	1.43	1.35	1.28	1.21	1.16	1.12		

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.
1916.	*Mm.*	*Mm.*	1916.	*Mm.*	*Mm.*	1916.	*Mm.*	*Mm.*	1916.	*Mm.*	*Mm.*
Oct. 1	4.37	6.27	Oct. 3	7.04	7.04	Oct. 2	2.62	10.97	Oct. 2	5.36	3.30
6	14.10	16.20	4	7.57	8.18	3	9.47	10.97	3	3.45	2.26
7	13.13	11.81	6	5.36	6.76	4	11.81	9.14	6	6.27	5.16
8	11.38	15.65	7	7.87	11.38	6	5.56	10.59	16	4.57	5.16
9	13.61	16.20	10	3.99	3.63	10	3.45	3.81	17	4.57	6.50
10	4.37	4.95	13	6.76	4.75	13	5.36	4.37	18	4.95	4.37
11	4.37	6.27	17	3.00	3.63	16	7.04	4.95	19	3.15	2.26
12	6.02	7.87	27	5.36	5.36	17	4.37	4.57	20	2.49	3.00
14	5.16	5.16	.....	.....	.....	20	1.60	2.87	21	2.87	3.15
17	13.61	5.16	.....	.....	.....	21	3.45	4.95	25	3.63	3.81
21	4.95	5.16	.....	.....	.....	25	4.37	5.16	26	3.15	3.81
23	4.75	5.79	.....	.....	.....	26	4.57	6.50	27	3.00	4.57
24	5.79	7.29	.....	.....	.....	27	4.57	7.29	28	4.75	2.62
25	5.79	9.47	.....	.....	.....	31	4.37	5.16	30	2.74	5.36
26	4.57	5.79	.....	.....	.....	.....	.....	.....	31	2.62	3.00
27	4.75	5.36	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	5.56	6.02	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table 3 shows about the normal amount of radiation for the month at Washington, a slight excess at Madison, and a deficiency of about 6 per cent at Lincoln.

TABLE 3.—*Daily totals and departures of solar and sky radiation during October, 1916.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.			Departures from normal.			Excess or deficiency since first of month.		
	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.	Washington.	Madison.	Lincoln.
1916.	*Gr.-cal.*	*Gr. cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
Oct. 1	470	399	226	125	115	−136	125	115	−136
2	364	378	394	23	97	35	148	212	−101
3	244	380	427	− 93	102	71	55	314	− 30
4	296	369	401	− 38	94	48	17	408	18
5	279	339	379	− 51	67	29	− 34	475	47
6	373	387	373	46	118	26	12	593	73
7	369	362	366	45	96	22	57	689	95
8	356	297	387	34	33	46	91	722	141
9	250	341	185	− 69	80	−153	22	802	− 12
10	467	396	399	151	138	64	173	940	52
11	396	329	191	83	74	−141	256	1,014	− 89
12	337	51	303	26	−202	− 26	282	812	−115
13	130	375	413	−178	125	87	104	937	− 28
14	404	322	334	99	75	11	203	1,012	− 17
15	234	182	80	− 68	− 62	−240	135	950	−257
16	108	284	363	−192	43	47	− 57	993	−210
17	332	351	393	35	112	80	− 22	1,105	−130
18	280	254	303	− 4	18	− 7	− 26	1,123	−137
19	90	203	126	−202	− 31	−181	−228	1,092	−318
20	211	33	434	− 78	−198	130	−306	894	−188
Decade departure							−479	−46	−240
21	368	162	365	82	− 66	65	−224	828	−123
22	297	112	289	13	−114	− 8	−211	714	−131
23	360	80	75	79	−143	−219	−132	571	−350
24	339	108	24	61	−112	−267	− 71	459	−617
25	287	64	369	11	−154	82	− 60	305	−535
26	354	182	330	80	− 33	46	20	272	−489
27	324	321	340	52	108	59	72	380	−430
28	324	151	172	54	− 60	−106	126	320	−536
29	289	38	287	22	−170	12	148	150	−524
30	160	273	173	−105	67	− 99	43	217	−623
31	308	270	307	− 55	66	38	− 12	283	−585
Decade departure							+294	−611	−307
Excess or deficiency since first of year:									
Gr.-cal							−5,531	3,286	
Per cent							−4.7	+2.9	

If we extrapolate the radiation intensities obtained on the best days to air mass 1 (zenithal sun) and air mass zero (upper limit of the atmosphere) by the method illustrated in the REVIEW for September, 1915, **43**:441, fig. 1, and then employ the latter in connection with the vapor pressures given in Table 2 to compute the solar constant by the Smithsonian "Abridged procedure for determining approximately the value of the solar constant," [1] the values in Table 4 result. The values of the solar constant obtained from the measurements made at Madison, Lincoln, and Santa Fe, are in good accord. Those obtained from Washington observations are too low, as we might expect, since during the fall months the tendency must be for vapor pressure readings near sea level to give too low a value for the total vapor content of the atmosphere.

TABLE 4.—*Radiation intensities for zenithal sun, reduced to mean solar distance of the earth, and approximate values of the solar constant.*

[Gram-calories per minute per square centimeter of normal surface.]

Station.	Date.	Radiation intensity.		Solar constant.
		m=1	m=0	
	1916.	*Gr.-cal.*	*Gr.-cal.*	*Gr.-cal.*
Washington, D. C.	Oct. 10, p. m.	1.49	1.71	1.84
	Oct. 26, a. m.	1.41	1.68	1.82
	Oct. 28, a. m.	1.43	1.69	1.83
Madison, Wis.	Oct. 10, a. m.	1.55	1.76	1.88
Lincoln, Nebr.	Oct. 3, a. m.	1.47	1.72	1.94
	Oct. 4, a. m.	1.40	1.66	1.88
	Oct. 13, a. m.	1.59	1.78	1.92
	Oct. 17, p. m.	1.53	1.76	1.89
	Oct. 25, a. m.	1.63	1.83	1.97
	Oct. 27, p. m.	1.58	1.83	1.99
	Oct. 31, p. m.	1.58	1.82	1.96
Mean				1.94
Santa Fe, N. Mex.	Oct. 3, a. m.	1.60	1.78	1.88
	Oct. 17, p. m.	1.54	1.71	1.85
	Oct. 19, p. m.	1.65	1.90	2.00
	Oct. 20, a. m.	1.63	1.80	1.90
	Oct. 25, p. m.	1.57	1.74	1.85
	Oct. 26, a. m.	1.63	1.78	1.89
	Oct. 26, p. m.	1.58	1.74	1.85
	Oct. 28, a. m.	1.57	1.70	1.83
	Oct. 30, a. m.	1.62	1.79	1.91
	Oct. 31, a. m.	1.61	1.76	1.86
Mean				1.88

Unusually high radiation intensities were measured at Lincoln, Nebr., on the morning of October 20, following a fall of about 4 inches of snow. By noon, however, the atmospheric transmission had diminished, so that the radiation intensity for air mass 1.5 had not increased over that obtained for air mass 2.0.

Skylight polarization measurements made at Washington on 14 days give a mean of 56 per cent and a maximum of 61 per cent on the 10th. This latter, which is 9 per cent less than the October maximum of 1915, is surprisingly low; since on several days, and notably on October 10, distant mountains could be seen with unusual clearness.

ADDITIONAL NOTE ON THE HIGH HAZE OF JULY AND AUGUST, 1916.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Washington, D. C., Dec. 4, 1916.]

In response to the request in connection with the note on "High Haze" in the August, 1916, REVIEW, **44**:433-434, the following description has been received from Mr. Cleve Hallenbeck, assistant observer, Weather Bureau, Roswell, N. Mex.

[1] Annals, Astrophysical Observatory of the Smithsonian Institution, Washington, 1908, **2**: 115.